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Complete Specification entitled (54) NOVEL COMPOSITIONS.

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Applicant (71) W.R. GRACE & CO.

Actual Inventor (72) THEOPHILES G. KOSSIVAS.

Related Art (56)

The following statement is a full description of this invention, including the best method of performing it known to us:

F. D. Attenborough, Government Printer, Canberra

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This invention is directed to an improvement in concrete compositions and particularly to compositions for improvements in the preparation of cellular concrete.

For many concrete applications, a porous or cellular composition is desired primarily to increase the workability of the concrete and to provide increased resistance in the finished concrete to deterioration caused by freezing and thawing. The term "cellular concrete" as used herein refers to concrete which is lighter in weight than normal concrete because of pores or voids therein. These voids are produced by adding to the concrete mixture a porosity-producing agent such as suitable air-entraining agents which retain air incorporated into the concrete by mixing or a gas-forming material which chemically produces gas in the concrete mixture. As examples of suitable air-entraining materials known to the art, mention may be made of natural wood resins and soaps, animal or vegetable fats and oils and alkali salts of sulfonated or sulfated organic compounds. As an example of a suitable gas-forming material, mention may be made of aluminum powder.

Such porosity-producing agents are generally employed at a level of 0.005 to 0.05 per cent by weight based on the weight of the cement. The aforementioned range is a preferred range and it should be understood that greater or lesser amounts are also employed depending upon the degree of porosity desired. The porosity-producing agents are either incorporated into the cement during manufacture or are added during the preparation of the concrete.

It has been found that porosity-producing agents have not been employed at full efficiency since there are factors present in the concrete mix in the very early stages

of setting which act against the porosity-producing agent and result in a relatively large volume of the very small gas bubbles escaping from the mix. For example, in some concrete mixes it has been found that as much as 40 percent less air is entrained than that predicted with a particular air-entraining agent.

A number of factors contribute to the loss of gas in the concrete mix; e.g., particle size distribution in the cement, ionic forces in the aqueous concrete phase and aggregate size. In addition, the employment of fly ash, a material commonly employed in cement, has been known to decrease the number of voids by 50 percent over a control without fly ash.

It has now been found that by the employment, as an additive, of a relatively small amount of polyvinyl alcohol with a porosity-producing agent, the above-described factors which militate against retention of gas are overcome to provide a uniform void structure and efficient employment of the porosity-producing agent. When polyvinyl alcohol is employed in a concrete mixture which normally retains a substantially lower amount of the voids than would be theoretically produced by the porosity-producing agent, greater amounts of voids are induced by means of novel compositions of the present invention. However, when the novel additive of the present invention is employed in a concrete mix which normally would retain the amount of gas expected based on the amount of porosity-producing agent, the presence of the polyvinyl alcohol does not result in an excessive degree of void formation. Generally, no more than the theoretical amount of gas is entrained.

Polyvinyl alcohol is preferably employed at levels ranging from 1 to 20 percent by weight based on the weight of the porosity-producing agent. In a particularly preferred embodiment, 6 to 8 percent is employed. Levels of polyvinyl alcohol as high as 200 percent and higher are employed without adverse effects.

In addition to increasing the efficiency of the porosity-producing agents, the novel additive of the present invention also minimizes the deteriorating effect which dusty aggregates have on the entrapped gas.

The novel composition of the present invention is particularly useful in concrete mixes which employ fly ash. The deleterious effect of the fly ash on the maintainance of voids is overcome by the novel composition.

Aggregate materials suitable for use in the present invention include the various classes of sand, cinders, slag, stone and shell aggregate. Also included are pozzolanic materials and light weight aggregate.

The term "hydraulic cement" as used herein is intended to refer to any of the various classes of hydraulic cements employed in concrete or masonry construction. These materials include Portland cement, lime or a blend of both. Particularly preferred is ASTM Type I Portland cement.

The following non-limiting examples illustrate the improvement in air content in Portland cement mixes employing polyvinyl alcohol in addition to an air-entraining agent. The same Type I Portland cement was used in all of the following series of examples. The air-entraining agent was a commercial air-entraining agent composed of wood rosin

and fatty acids. Air content was determined by ASTM C-185 Test method.

Example No.	Control.	1	2	3	4	5	6	7
% by weight air-entraining agent based on weight of cement.	0.0138	0.0138	0.0138	0.0138	0.0138	0.0138	0.0138	0.0081
% by weight polyvinyl alcohol based on weight of air-entraining agent solids.	----	360	180	90	43.5	14.5	7.2	12.4
water/cement ratio	.51	.50	.50	.50	.51	.51	.51	.51
slump-inches	3.0	3.5	3.5	3.0	3.5	3.25	3.5	3.0
% air	3.5	9.5	8.7	7.0	5.8	5.5	4.9	4.7

A comparison of Examples 6 and 7 show that substantially the same amount of air can be retained in the mortar mix with 0.0081% air-entraining agent plus polyvinyl alcohol as with 0.0138% air-entraining agent above. Examples 1, 2 and 3 show that unusually large amounts of polyvinyl alcohol can be employed to efficiently entrap air without any adverse effects.

The polyvinyl alcohol is added as a dry powder or as a water solution. Preferably a water solution is employed to provide more rapid distribution in the mortar and/or concrete mix. In a particularly preferred embodiment, the

polyvinyl alcohol is premixed with the air-entraining agent and the two additives are incorporated into the mortar and/or concrete together.

Since changes may be made in the above products without departing from the scope of the invention. It is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

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mortar and/or

products
1. It is
description
a limiting

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The claims defining the invention are as follows:

1. A novel composition comprising a porosity-producing agent for concrete and polyvinyl alcohol.

(20th May, 1966)

2. A novel composition as defined in Claim 1, wherein said polyvinyl alcohol is employed at a level of 1 to 20 percent by weight based on the weight of porosity-producing agent.

(20th May, 1966)

3. A novel composition particularly suitable for producing cellular concrete comprising (1) hydraulic cement, (2) polyvinyl alcohol, and (3) a porosity-producing agent.

(20th May, 1966)

4. A composition as defined in Claim 3, wherein said porosity-producing agent is present at a level of 0.005 to 0.05 percent by weight based on the weight of the cement and said polyvinyl alcohol is employed at a level of 1 to 20 percent by weight based on the weight of porosity-producing agent.

(20th May, 1966)

5. A composition as defined in Claim 4 wherein 6 to 8 percent of said polyvinyl alcohol is employed.

(20th May, 1966)

6. A composition as defined in Claim 3, wherein said porosity-producing agent is a mixture of wood rosin and fatty acids.

(20th May, 1966)

7. A cellular concrete obtained by admixing water, hydraulic cement, polyvinyl alcohol, and a porosity-producing agent.

(20th May, 1966)

8. A product as defined in Claim 7, wherein said concrete contains aggregate.

(20th May, 1966)

9. A product as defined in Claim 7, wherein said porosity-producing agent is employed at a level of 0.005 to 0.5 percent by weight based on the weight of cement and said polyvinyl alcohol is employed at a level of 1 to 20 percent by weight based on the weight of said porosity-producing agent.

(20th May, 1966)

10. A product as defined in Claim 7, wherein said porosity-producing agent is wood rosin and fatty acids.

(20th May, 1966)

11. A product as defined in Claim 7, wherein said concrete contains fly ash.

(20th May, 1966)

DATED this 10th day of May, A.D.1967

W. R. Grace & Co.
By its Patent Attorneys,
PHILLIPS ORMONDE LePLASTRIER &
KELSON.